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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/617,843	07/11/2003	Adam William Saxler	5308-248	7985
20792	7590	04/20/2005	EXAMINER	
MYERS BIGEL SIBLEY & SAJOVEC			TOLEDO, FERNANDO L	
PO BOX 37428			ART UNIT	
RALEIGH, NC 27627			PAPER NUMBER	
			2823	

DATE MAILED: 04/20/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

SM

**Office Action Summary**

Application No.

10/617,843

Applicant(s)

SAXLER ET AL.

Examiner

Fernando L. Toledo

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**-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --****Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 20 December 2004.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-46 is/are pending in the application.
- 4a) Of the above claim(s) 4, 6, 38 and 39 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1, 2, 5, 7-27, 34, 40-42 and 44-46 is/are rejected.
- 7) ☒ Claim(s) 3, 28-33, 35-37 and 43 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 11 July 2003 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |   |   |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>20050126</u> | 6) <input type="checkbox"/> Other: _____  |

## DETAILED ACTION

### *Claim Rejections - 35 USC § 102*

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1, 2, 5, 7 – 12, 14, 15, 17, 18, 20 – 24, 26, 27, 34, 40 – 42 and 44 – 46 are rejected under 35 U.S.C. 102(e) as being anticipated by Nakayama et al. (U. S. patent 6,492,669 B2).

In re claims 1, 42, 44 and 46, Nakayama, in the U. S. patent 6,492,669 B2; figures 1 – 16 and related text, discloses forming a nitride-based channel layer 3 on a substrate; forming a nitride-based semiconductor first cap layer 5 on the nitride-based channel layer; forming a mask that covers a first portion of the cap layer and exposes an adjacent second portion of the first cap layer (Figure 2A); forming a nitride-based semiconductor second cap layer 6 on the exposed second portion of the first cap layer using the mask; removing a portion of the mask to form a recess on the first portion of the first cap layer adjacent the second cap layer (Figure 2A); forming one of an ohmic contact 7 or a gate contact in the recess; and forming a corresponding gate contact or ohmic contact 8 on the substrate.

3. In re claim 2, Nakayama discloses wherein forming a corresponding gate contact or ohmic contact comprises forming the corresponding gate contact or ohmic contact on the second cap layer (Figure 2A).

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4. In re claim 5, Nakayama discloses wherein removing at least a portion of the mask to form a recess on the first portion of the first cap layer adjacent the second cap layer comprises removing the mask to expose the first portion of the first cap layer and to form a recess adjacent the second cap layer, and wherein forming one of an ohmic contact or a gate contact comprises forming one of an ohmic contact or a gate contact on the exposed portion of the first cap layer (Figure 2A).

5. In re claims 7 and 45, Nakayama discloses wherein forming a nitride-based channel layer comprises forming a Group III-nitride layer (Column 8, Lines 14 – 16); wherein forming a nitride-based semiconductor first cap layer comprises forming a Group III-nitride layer (Column 8, Lines 14 – 16); and wherein forming a nitride-based semiconductor second cap layer comprises growing a Group-III nitride layer (Column 8, Lines 46 – 48).

6. In re claim 8, Nakayama discloses wherein the channel layer has a composition of  $\text{Al}_x\text{Ga}_{1-x}\text{N}$  wherein  $0 \leq x < 1$ , and wherein the bandgap of the channel layer is less than the bandgap of the first cap layer (Column 8, Lines 16 – 20).

7. In re claim 9, Nakayama discloses, wherein the channel layer comprises GaN, InGaN, and/or AlInGaN (Column 8, Lines 16 – 20).

8. In re claim 10, Nakayama discloses, wherein the channel layer comprises an undoped layer having a thickness of greater than about 20 Å (Column 9, Line 6).

9. In re claim 11, Nakayama discloses wherein the channel layer comprises a superlattice and/or a combination of Group III-nitride layers (Column 8, Lines 27 – 33).

10. In re claim 12, Nakayama discloses wherein the channel layer comprises aluminum gallium nitride (AlGaN), gallium nitride (GaN), indium gallium nitride (InGaN), and/or

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aluminum indium gallium nitride (AlInGaN) (Column 8, Lines 16 – 20); wherein the first cap layer comprises aluminum nitride (AlN), aluminum indium nitride (AlInN), AlGaN, GaN, InGaN, and/or AlInGaN (Column 8, Lines 16 – 20); and wherein the second cap layer comprises aluminum nitride (AlN), AlInN, AlGaN, GaN, InGaN, and/or AlInGaN (Column 8, Line 48).

11. In re claim 14, Nakayama discloses wherein the first cap layer is undoped or doped with an n-type dopant to a concentration less than about  $10^{19}\text{cm}^{-3}$  (Column 9, Line 8).

12. In re claim 15, Nakayama discloses the first cap layer comprises  $\text{Al}_x\text{Ga}_{1-x}\text{N}$  wherein  $0 < x < 1$  (Column 8, Lines 16 – 20).

13. In re claim 17, Nakayama discloses wherein the first cap layer comprises AlGaN with an aluminum concentration of between about 5% and about 100% (Column 8, Lines 16 – 20).

14. In re claim 18, Nakayama discloses wherein the first cap layer has an aluminum concentration greater than about 10% (Column 8, Lines 16 – 20).

15. In re claim 20, Nakayama discloses wherein the channel layer has a lower bandgap than the first cap layer (Column 8, Lines 20 – 22).

16. In re claim 21, Nakayama discloses wherein forming a mask comprises patterning a mask layer using one of a lift-off technique or a wet-etch technique (Column 9, Lines 20 – 26).

17. In re claim 22, Nakayama discloses wherein forming a mask comprises forming the mask from a silicon oxide ( $\text{SiO}_x$ ), a silicon nitride ( $\text{SiN}_x$ ) or an AlN-based material (Column 9, Lines 20 – 26).

18. In re claim 23, Nakayama discloses wherein the second cap layer comprises the same material as the first cap layer (Column 8, Lines 16 – 20 and 46 – 48).

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19. In re claim 24, Nakayama discloses wherein the first and second cap layers comprise AlGa<sub>N</sub>, and wherein the first cap layer has a higher concentration of Al than the second cap layer (Column 8, Lines 16 – 20 and 46 – 48).

20. In re claim 26, Nakayama discloses wherein the second cap layer has an orientation such that terminating edges of the second cap layer are not orthogonal to preferred crystal crack directions (Column 8, Lines 55 –64).

21. In re claim 27, Nakayama discloses wherein the second cap layer has an Al composition below the level at which a substantial second electron channel forms at a regrowth interface between the first cap layer and the second cap layer (Column 8, Lines 51 – 54).

22. In re claim 34, Nakayama discloses wherein forming the nitride-based channel layer is preceded by forming a buffer layer 2 on the substrate, and wherein forming a nitride-based channel layer comprises forming the nitride-based channel layer on the buffer layer (Figure 2A).

23. In re claim 40, Nakayama discloses wherein forming a nitride-based semiconductor second cap layer comprises growing the second cap layer on the exposed portion of the first cap layer (Column 9, Lines 5 – 15).

24. In re claim 41, Nakayama discloses wherein the channel layer and the first and second cap layers are configured to provide a High Electron Mobility Transistor (HEMT) (Figure 2A).

***Claim Rejections - 35 USC § 103***

25. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

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having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

26. Claims 13, 16, 19 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakayama as applied to claims 1, 2, 5, 7 – 12, 14, 15, 17, 18, 20 – 24, 26, 27, 34, 40 – 42 and 44 – 46 above.

In re claims 13, 16 and 19, Nakayama discloses wherein the first cap layer comprises AlN, AlInN, AlGaN, and/or AlInGaN and has a thickness of about 20nm (Column 9, Lines 1 – 8). Nakayama does not show wherein the thickness of the first cap layer is of 1nm to about 10nm or 3nm to 15nm or 0.3nm to about 4nm.

However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to form the first cap layer of Nakayama with a thickness of 1nm to about 10nm or 3nm to 15nm or 0.3nm to about 4nm, since thickness is a well-known process variable and determining the optimum ranges requires only routine experimentation by one of ordinary skill in the art. Note that the specification contains no disclosure of either the critical nature of the claimed thicknesses or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen thicknesses or upon another variable recited in a claim, the Applicant must show that the chosen thicknesses are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). In addition, the selection of a thickness range, its obvious because it is a matter of determining optimum process conditions by routine experimentation with a limited number of species of result effective variables. These claims are prima facie obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996)(claimed ranges or a result effective variable,

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which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill or art) and *In re Aller*, 105 USPQ 233 (CCPA 1995) (selection of optimum ranges within prior art general conditions is obvious).

27. In re claim 25, Nakayama discloses wherein a combined thickness of the first and second cap layers is about 30nm. Nakayama does not disclose wherein the combined thickness is about 25nm.

However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to form the first and second cap layers of Nakayama with a combined thickness of 25nm, since thickness is a well-known process variable and determining the optimum ranges requires only routine experimentation by one of ordinary skill in the art. Note that the specification contains no disclosure of either the critical nature of the claimed thicknesses or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen thicknesses or upon another variable recited in a claim, the Applicant must show that the chosen thicknesses are critical. *In re Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990). In addition, the selection of a thickness range, its obvious because it is a matter of determining optimum process conditions by routine experimentation with a limited number of species of result effective variables. These claims are prima facie obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688 (Fed. Cir. 1996)(claimed ranges or a result effective variable, which do not



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overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Boesch*, 205 USPQ 215 (CCPA) (discovery of optimum value of result effective variable in known process is ordinarily within skill or art) and *In re Aller*, 105 USPQ 233 (CCPA 1995) (selection of optimum ranges within prior art general conditions is obvious).

### *Claim Objections*

28. Claims 3, 28 – 33, 35 – 37 and 43 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

### *Response to Arguments*

29. Applicant's arguments filed 20 December 2004 have been fully considered but they are not persuasive for the following reasons.

30. Applicant contests the following:

In contrast, the claims recite operations in which a second nitride-based layer is formed on a first nitride-based layer using a mask that is subsequently removed to form a contact recess. Such recitations are neither disclosed nor suggested by Nakayama and, for at least these reasons, Applicant submits that independent claims 1 and 42 are patentable over Nakayama.

Examiner respectfully submits that Nakayama suggests the aforementioned operations. Nakayama shows a second cap layer 6 formed on the first cap layer 5 as recited in the claims, see Column 9, Lines 20 – 34.

***Conclusion***

31. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Fernando L. Toledo whose telephone number is 571-272-1867. The examiner can normally be reached on Mon-Thu 7am to 5:30pm.

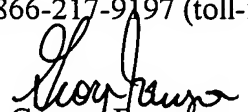
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



F. Toledo  
14 April 2005



George Hourson  
Primary Examiner  
Art Unit 2823